SCIENCE

FRIDAY, MARCH 30, 1888.

THE ANNUAL INQUIRY into the management of the Government Printing-Office by a committee of the National House of Representatives is now in progress. It matters little what conclusions this committee may reach, if, like its predecessors, it does not devise some method of hastening not only the printing of Congress, but also that of the departments. Nowhere is this delay more keenly felt than in the scientific bureaus. Much of the material gathered in these with great labor and expense loses value with delay in publication. Take the work of the United States Geological Survey, for instance. Although the manuscript for the eighth annual report has been completed, the seventh has not yet been printed. The eighth report contains, among other things, an able discussion of the Trenton limestone as a source of petroleum and natural gas, by Professor Orton, State geologist of Ohio. This is a subject upon which information is most eagerly sought in many parts of the country, and it should be published immediately. But there is no probability that it will appear for a year or more, and in the mean time no one can tell what new discoveries or developments may be made. A large number of bulletins issued by the Geological Survey are also in the hands of the printer, with no immediate prospect of their being finished. The cost of printing these reports is very small in comparison with that of their preparation, and some means ought to be devised for their speedy appearance after the 'copy' goes to the printer.

THERE ARE SEVERAL BRANCHES of scientific work pursued in Washington, at the expense of the government, which are still in need of proper, systematic, scientific direction. This is not true of the Coast Survey, Naval Observatory, the Geological Survey, the Fish Commission, or the Smithsonian Institution and the National Museum. In each of these there is a general purpose which is intelligently pursued. But in some other departments, notably in the Agricultural Department, while there is much valuable original investigation going on, there is also much that is desultory and misdirected. This is not so much attributable to the workers themselves as to the lack of intelligent scientific direction. This trouble is aggravated, also, by the fact that in this and some other departments the annual appropriations are made for specific purposes; and it becomes necessary every year for the scientific worker to convince a new committee of the utility of his labors in order to secure the money to keep him employed until the next appropriation bill is passed. This leads not only to jealousies, but acts as a continuous temptation to do showy work rather than that of permanent value, and to the exaggeration of the importance of some branches of inquiry and the neglect of others of greater moment. It has also resulted in the pursuance of some investigations far beyond the limit of economical or useful inquiry, and the publication of very expensive books, which are of no value whatever to the farmers of the country, and of very little to science. What is needed is that the heads of all such departments shall be selected both for their scientific attainments and for their executive ability, and that they shall not be considered as political officers, to be changed with each new administration. They should be men capable of passing an intelligent judgment upon the scientific work performed by their subordinates, and of giving to it proper direction. As it is, the heads of the several scientific bureaus of the Agricultural Department seem all to be working independently, some wisely and to useful purpose, and some otherwise.

THE ANNUAL REPORT of the New York State Reformatory deserves a word of notice, and that word must always be one of hearty commendation. This institution, that embodies so many of the wisest and advanced views upon the true end in view in the treatment of the prisoner, and the ways that science teaches leads to such ends, is rapidly coming to be regarded as the pattern for reformatory institutions everywhere. The report for the year 1887 gives evidence that the work is going on, ever developing further improvements, and increasing the efficiency of those that have been adopted. The statistical tables showing the career of all those who have 'graduated' from the institution tell their own tale: in brief, they tell us that the public have a guaranty of protection from 90%, and of reformation from 83.3%, of all released, — certainly astounding figures. The portion of the reformatory process that strikes the average observer as most remarkable is the literary instruction. That classes in English literature, in ethics, in psychology, should be attended with a deep interest by these men, seems surprising indeed; and, when one learns the high character of this instruction, the surprise is doubled. Yet the facts are unmistakable; and the statement of the literature instructor, that the beauties of literary production can readily arouse a sympathetic chord in the minds of those whom we regard as outcasts of society, strongly suggests the remark, that, were the educational institutions outside the reformatory conducted upon equally scientific principles, there would be less need of reformatories. The managers subscribe to this statement: "The success which has attended the methods practised in the reformatory for the reclamation of first offenders is sufficiently assured and recognized among penologists and humanitarians generally, to warrant its more extended adoption in place of ordinary prison administration, which for so long a period has been in operation in the State of New York. Without attempting to disparage that system, the attention of the Legislature is respectfully called to the reports of the general superintendent, the school secretary, and the physician of the reformatory, for more detailed information in support of this recommendation."

THE ANTHROPOMETRICAL METHOD of identifying criminals, originating from Paris, has been adopted in the prison at Joliet, Ill. In addition to the photograph of the prisoner, accurate measurements of his height, the length and width of his head, the length of the left middle and little finger, of the foot, the fore-arm, the ear, the stretch of the arms, description of scars, color of the eyes, and so on, are recorded; and it is thus possible to identify prisoners assuming false names with far greater ease than was before possible. It is asserted, that, in the two years that the system has been in operation in Paris, 826 habitual criminals arrested under assumed names have been identified. Besides the practical utility of the system, it amasses very valuable statistical data contributing towards the natural history of the criminal classes.

SUPERINTENDENT MACALISTER of Philadelphia has arranged for a representative exhibit of the school-work of that city from May 9 to May 12 next. The exhibit will be placed in Horticultural Hall, and will undoubtedly attract a large number of visitors from other cities. Under Mr. MacAlister, Philadelphia's schools have become the most progressive in the country, and many other superintendents and principals will be glad to get the benefit of their methods and results. The exhibit will include all kinds of school-work that can be represented graphically or objectively; viz., manual-training,

industrial-art work, sewing, kindergarten work, drawing, map-drawing, penmanship, clay-modelling, and manual work of every kind produced in the schools. The pupils' work will form the most important part of the exhibit, and will be a full and fair exhibit of the regular work done in the schools since September last. An interesting feature will be the historical exhibit. This will consist of two schoolrooms so fitted up as to represent and contrast the arrangement and conveniences for public-school education furnished by Philadelphia to-day and half a century ago. This exhibit will unquestionably prove a strong stimulus to progress and improvement to the teachers and pupils of the Philadelphia schools, as well as an attractive object of interest to those in other cities.

ADDRESS OF HON. GARDINER G. HUBBARD, PRESIDENT OF THE NATIONAL GEOGRAPHIC SOCIETY, AT ITS FIRST MEETING, MARCH, 1888.

I AM not a scientific man, nor can I lay claim to any special knowledge that would entitle me to be called a 'geographer.' I owe the honor of my election as president of the National Geographic Society simply to the fact that I am one of those who desire to further the prosecution of geographic research. I possess only the same general interest in the subject of geography that should be felt by every educated man.

By my election you notify the public that the membership of our society will not be confined to professional geographers, but will include that large number who, like myself, desire to promote special researches by others, and to diffuse the knowledge so gained among men, so that we may all know more of the world upon which we live.

By the establishment of this society, we hope to bring together (1) the scattered workers of our country, and (2) the persons who desire to promote their researches. In union there is strength, and through the medium of a national organization we may hope to promote geographic research in a manner that could not be accomplished by scattered individuals or by local societies; we may also hope (through the same agency) to diffuse the results of geographic research over a wider area than would otherwise be possible.

The position to which I have been called has compelled me to become a student. Since my election I have been trying to learn the meaning of the word 'geography,' and something of the history of the science to which it relates. The Greek origin of the word (ἡ γῆ, 'the earth;' and γράφω, 'I write') betrays the source from which we derived the science, and shows that it relates to a description of the earth. But the 'earth' known to the Greeks was a very different thing from the earth with which we are acquainted.

To the ancient Greek it meant land; not all land, but only a limited territory, in the centre of which he lived. His earth comprised simply the Persian Empire, Italy, Egypt, and the borders of the Black and Mediterranean Seas, besides his own country. Beyond these limits the land extended indefinitely to an unknown distance, till it reached the borders of the great ocean which completely surrounded it.

To the members of this society the word 'earth' suggests a very different idea. The term arouses in our minds the conception of an enormous globe suspended in empty space, one side in shadow, and the other bathed in the rays of the sun. The outer surface of this globe consists of a uniform, unbroken ocean of air, enclosing another, more solid surface (composed partly of land, and partly of water), which fairly teems with countless forms of animal and vegetable life. This is the earth of which geography gives us a description.

To the ancients the earth was a flat plain, solid and immovable, and surrounded by water, out of which the sun rose in the east, and into which it set in the west. To them 'geography' meant simply a description of the lands with which they were acquainted.

Herodotus, who lived about the year 450 B.C., transmitted to posterity an account of the world as it was known in his day. We look upon him as the father of geography as well as of history. He visited the known regions of the earth, and described accurately what he saw, thus laying the foundations of *comparative geography.*

About 300 years B.C., Alexander the Great penetrated into hitherto unknown regions, conquered India and Russia, and founded the Macedonian Empire. He sent a naval expedition to explore the coasts of India, accompanied by philosophers or learned men, who described the new countries discovered and the character of their inhabitants. This voyage may be considered as originating the science of political geography, or the *geography of man.*

About the year 200 B.C., Eratosthenes of Cyrene, the keeper of the Royal Library at Alexandria, became convinced, from experiments, that the idea of the rotundity of the earth, which had been advanced by some of his predecessors, was correct, and attempted to determine upon correct principle the magnitude of the world. The town of Cyrene, on the river Nile, was situated exactly under the tropic, for he knew that on the day of the summer solstice the sun's rays illuminated at noon the bottom of a deep well in that city. At Alexandria, however, on the day of the summer solstice, Eratosthenes observed that the vertical finger of a sun-dial cast a shadow at noon, showing that the sun was not there exactly overhead. From the length of the shadow he ascertained the sun's distance from the zenith to be 7°12′, or one-fiftieth part of the circumference of the heavens; from which he calculated, that, if the world was round, the distance between Alexandria and Cyrene should be one-fiftieth part of the circumference of the world. The distance between these cities was 5,000 stadia, from which he calculated that the circumference of the world was fifty times this amount, or 250,000 stadia. Unfortunately we are ignorant of the exact length of a stadium, so we have no means of testing the accuracy of his deduction. He was the founder of *mathematical geography.*

It became possible through the labors of Eratosthenes to determine the location of places on the surface of the earth by means of lines corresponding to our lines of latitude and longitude. Claudius Ptolemy, in the second century of the Christian era, made a catalogue of the positions of plans as determined by Eratosthenes and his successors, and, with this as his basis, he made a series of twenty-six maps, thus exhibiting at a glance, in geographical form, the results of the labors of all who preceded him. To him we owe the art of map-making, — the *origination of geographic art.*

We thus see that when Rome began to rule the world, the Greeks had made great progress in geography. They already possessed comparative, political, and mathematical geography, and geographic art, or the art of making maps. Then came a pause in the progress of geography.

The Romans were so constantly occupied with the practical affairs of life, that they paid little attention to any other kind of geography than that which facilitated the administration of their empire. They were great road-builders, and laid out highways from Rome to the farthest limits of their possessions. Maps of their military roads were made, but little else. These exhibited with accuracy the less and greater stations on the route from Rome to India, and from Rome to the farther end of Britain.

Then came the decline and fall of Rome, and with it the complete collapse of geographical knowledge. In the dark ages, geography practically ceased to exist. In the typical map of the middle ages, Jerusalem lay in the centre, with Paradise on the east, and Europe on the west. It was not until the close of the dark ages that the spirit of discovery was re-awakened. Then the adventurous Northmen from Norway and Sweden crossed the ocean to Iceland.

From Iceland they proceeded to Greenland, and even visited the mainland of North America about the year 1000 A.D., coasting as far north as New England; but these voyages led to no practical results, and were forgotten, or looked upon as myths, until within a few years. For hundreds of years geography made but little advance, and the discoveries of five centuries were less than those now made in five years. In the fourteenth or fifteenth century the mariner's compass was introduced into Europe from China, and it then became possible to venture upon the ocean far out of sight of land. Columbus, instead of coasting from shore to shore like the ancient Northmen, boldly set sail across the Atlantic. To many of his contemporaries it must have seemed madness to seek the east by thus sailing towards the west, and we need hardly wonder at the opposition experienced from his crew. The rotun-

dity of the earth had become to him an objective reality, and in sublime faith he pursued his westward way. Expecting to find the East Indies, he found America instead. Five centuries had elapsed since the Northmen had made their fruitless voyages to these shores, and their labors had proved to be barren of results. The discovery of Columbus, however, immediately bore fruit. It was his genius and his perseverance alone that gave the New World to the people of Europe, and he is therefore rightfully entitled to be called the discoverer of America. His discovery was fraught with enormous consequences, and it inaugurated a new era for geographic research. The spirit of discovery was quickened, and geographic knowledge advanced with a great leap. America was explored, Africa was circumnavigated. Magellan demonstrated the rotundity of the world by sailing due west until he reached his starting-point. Everywhere, all over the civilized world, the spirit of adventure was aroused. Navigators from England, Holland, France, and Spain rapidly extended the boundaries of geographical knowledge, while explorers penetrated into the interior of the new lands discovered. The mighty impetus given by Columbus set the whole world in motion, and it has gone on moving ever since with accelerated velocity.

The great progress that has been made can hardly be realized without comparing the famous Borgia map, constructed about one hundred years before the discovery of America, with the modern maps of the same countries; or Hubbard's map of New England, made two hundred years ago, with the corresponding map of to-day. The improvements in map-making originated with Mercator, who, in 1556, constructed his cylindrical projection of the sphere. But it was only during the last one hundred years that great progress was made. Much yet remains to be done before geographic art can fully accomplish its mission.

The present century forms a new era in the progress of geography, — the era of organized research. In 1830 the Royal Geographical Society of England was founded, but it already forms a landmark in the history of discovery. The Paris Society preceded it in point of time, and the other countries of Europe soon followed the example. Through these organizations, students and explorers have been encouraged and assisted, and information systematically collected and arranged. The wide diffusion of geographical knowledge through the medium of these societies, and the publicity of the discussions and criticism that followed, operated to direct the current of exploration into the most useful channels. Before organized effort, darkness gave way at every step. Each observer added fresh knowledge to the existing store, without unnecessary duplication of research. The reports of discoveries were discussed and criticised by the societies, and the contributions of all were co-ordinated into one great whole.

America refuses to be left in the rear. The American Geographical Society, so long and wisely presided over by Chief-Justice Daly, has kept pace with the foreign societies. Explorers from America are in every land and on every sea. Already she has contributed her quota of martyrs in the frozen North, and has led the way into the torrid regions of Africa. The people of Europe, through Columbus, opened up a new world for us; and we, through Stanley, have discovered a new world in the old, for them.

Much has been done on land, little on the other three-quarters of the earth's surface. But here America has laid the foundations of a new science, — the geography of the sea.

Our explorers have mapped out the surface of the ocean, and discovered the great movements of the waters. They have traced the southward flow of the Arctic waters to temper the climate of the torrid zone. They have followed the northward set of the heated waters of the equator, and have shown how they form those wonderful rivers of warm water that flow, without walls, through the colder waters of the sea, till they strike the western shores of Europe and America, and how they render habitable the almost arctic countries of Great Britain and Alaska. They have even followed these warm currents farther, and shown how they penetrate the Arctic Ocean to lessen the rigors of the Arctic cold. Bravely but vainly have they sought for that *ignis fatuus* of explorers — the open polar sea — produced by the action of the warm waters from the south.

American explorers have sounded the depths of the ocean, and discovered mountains and valleys beneath the waves. They have found the great plateaus on which the cables rest that bring us into instantaneous communication with the rest of the world. They have shown the probable existence of a vast submarine range of mountains, extending nearly the whole length of the Pacific Ocean, — mountains so high that their summits rise above the surface, to form islands and archipelagoes in the Pacific. And all this vast region of the earth, which, a few years ago, was considered uninhabitable on account of the great pressure, they have discovered to be teeming with life. From the depths of the ocean they have brought living things, whose lives were spent under conditions of such pressure that the elastic force of their own bodies burst them open before they could be brought to the surface; living creatures whose self-luminous spots supplied them with the light denied them in the deep abyss from which they sprang, — abysses so deep that the powerful rays of the sun could only feebly penetrate to illuminate or warm.

The exploring vessels of our Fish Commission have discovered in the deep sea, in one single season, more forms of life than were found by the 'Challenger' Expedition in a three-years' cruise. Through their agency we have studied the geographical distribution of marine life; and in our marine laboratories, explorers have studied the life-history of the most useful forms.

The knowledge gained has enabled us to breed and multiply at will; to protect the young fish during the period of their infancy (when alone they are liable to wholesale destruction); finally to release them in the ocean, in those waters that are most suitable to their growth. The fecundity of fish is so great, and the protection afforded them during the critical period of their life so ample, that it may now be possible to feed the world from the ocean, and set the laws of Malthus at defiance. Our geographers of the sea have shown that an acre of water may be made to produce more food for the support of man than ten acres of arable land. They have thrown open to cultivation a territory of the earth constituting three-quarters of the entire surface of the globe.

And what shall we say of our conquests in that other vast territory of the earth, greater in extent than all the oceans and the lands put together, — the atmosphere that surrounds the world.

Here, again, America has led the way, and laid the foundations of a geography of the air. But a little while ago, and we might have truly said with the ancients, "The wind bloweth where it listeth, and we know neither from whence it comes, nor whither it goes;" while now our explorers track the wind from point to point, and telegraph warnings in advance of the storm.

In this department — the geography of the air — we have far outstripped the nations of the world. We have passed the mob-period of research, when the observations of multitudes of individuals amounted to little, from lack of concentrated action. Organization has been effected. A central bureau has been established in Washington, and an army of trained observers have been dispersed over the surface of the globe, who all observe the condition of the atmosphere according to a preconcerted plan.

The vessels of our navy, and mercantile marine of our own and other countries, have been impressed into the service: thus our geographers of the air are stationed in every land, and traverse the waters of every sea. Every day, at the same moment of absolute time, they observe and note the condition of the atmosphere at the part of the earth where they happen to be, and the latitude and longitude of their position. The collocation of these observations gives us a series of what may be termed 'instantaneous photographs' of the condition of the whole atmosphere. The co-ordination of the observations, and their geographical representation upon a map, are undertaken by a staff of trained experts in the central bureau in Washington, and through this organization we obtain a weather-map of the world for every day of the year. We can now study at leisure the past movements of the atmosphere, and from these observations we shall surely discover the grand laws that control aerial phenomena. We shall then not only know, as we do at present, whence comes the wind and whither it goes, but be able to predict its movements for the benefit of humanity.

Already we have attained a useful though limited power of prediction.

Our central bureau daily collects observations by telegraph from

all parts of this continent, and our experts are thus enabled to forecast the probabilities by a few hours. Day by day the results are communicated to the public by telegraph in time to avert disaster to the mariners on our eastern coast, and facilitate agricultural operations in the Eastern and Middle States.

Although many of the predictions are still falsified by events, the percentage of fulfilments has become so large as to show that continued research will in the future give us fresh forms of prediction, and increase the usefulness of this branch of science to mankind.

In all departments of geographical knowledge, Americans are at work. They have pushed themselves into the front rank, and they demand the best efforts of their countrymen to encourage and support.

When we embark on the great ocean of discovery, the horizon of the unknown advances with us, and surrounds us wherever we go. The more we know, the greater we find is our ignorance. Because we know so little, we have formed this society for the increase and diffusion of geographical knowledge. Because our subject is so large, we have organized the society into four broad sections, relating to the geography of the land (H. G. Ogden, vice-president), the sea (J. R. Bartlett, vice-president), the air (A. W. Greely, vice-president), the geographical distribution of life (C. H. Merriam, vice-president); to which we have added a fifth, relating to the abstract science of geographic art, including the art of map-making, etc. (A. H. Thompson, vice-president). Our recording and corresponding secretaries are Henry Gannett and George Kennan.

We have been fortunate indeed to secure as vice-presidents and secretaries men learned in each department, and who have been personally identified with the work of research.

WATER-SPOUTS OFF THE ATLANTIC COAST OF THE UNITED STATES.

THE Hydrographic Office has published a very interesting supplement to the Pilot Chart of the North Atlantic Ocean, showing the positions of water-spouts sighted by masters of vessels during January and February in the western portion of the North Atlantic. The map, which is reproduced here, is accompanied by remarks of Everett Hayden, of which we give the following abstract: —

"Although the reports now at hand for these two months were received from incoming vessels only, yet they are very characteristic, and indicate fairly well the regions where these phenomena are of most frequent occurrence.

"Before quoting the reports themselves, it may be well briefly to refer to what is known regarding the character and formation of water-spouts, which are simply special cases of whirlwinds and tornadoes, as these are special cases of cyclones, but on a much smaller scale.

"When a whirlwind is formed over the ocean, water is often drawn up the centre of the whirl some distance, owing to the suction created, and at the same time the moisture in the air is condensed as it rises, so that the name 'water-spout' is very applicable. Indeed, sometimes a spout will burst over a vessel, and flood her decks with water, as a cloud-burst does a mountain-side. When a spout is forming, its upper portion is often visible first, seeming to grow downwards from the clouds. By observing carefully with a telescope, however, it will be seen that the motion in the column itself is upwards, although the moisture in the air which is rising is condensed lower and lower down, thus rendering the whirl visible lower down continually, and making it appear to be actually descending.

"On Jan. 12, Captain Hess, American steamship 'Philadelphia,' saw four water-spouts in latitude 36° 41′ north, longitude 72° 27′ west. On the 19th, Captain Lawson, British steamship 'Lizzie English,' reports several a little farther to the eastward (latitude 36° 41′ north, longitude 71° 40′ west); and from the Dutch steamship 'Edam,' Captain van der Zee, a detailed report has been received from third officer De Boerk of a large spout sighted at 7 A.M., Jan. 21, latitude 41° 50′ north, longitude 60° 25′ west. In the last case the spout is described as being small and straight at the base, increasing in size towards the top, where it mingled with the clouds. Ascending currents could be plainly seen; there was a strong westerly gale at the time, with occasional hail and snow; temperature of the air 0° C.; water, 11°; direction of rotation of the whirl, with the hands of a watch.

"Another very complete report has been received from Captain Dexter, American steamship 'City of Para,' who saw several large spouts, Jan. 22, in latitude 31° 47′ north, longitude 74° 33′ west. The wind was strong from the north-east, and the sky overcast, with light scud, but the sea was comparatively smooth. Three huge spouts were seen at once, and six in the course of half an hour. The water seemed to be drawn up from the sea, mounting in spiral columns of tremendous thickness, with a loud, roaring sound. Some of the columns were vertical, some inclined at a considerable angle; all of them increased in size at the top, and blended with the clouds. A fine rain or mist filled the air, and continued for some time. The wind soon after changed to east.

"Perhaps the most interesting cases of all, however, are those which were reported Jan. 26, 27, and 28, for the reason that they were clearly associated with a low-barometer area of considerable energy, which moved across the Great Lakes on the 25th, and was central off Nantucket on the 26th. It has been clearly shown by the United States Signal Service, that, when tornadoes occur on land, they take place almost invariably in the southern quadrants of an area of low barometer. It might therefore be expected that whirlwinds and water-spouts would sometimes be found associated in a similar way with a cyclonic storm at sea. The following reports seem to leave no doubt that such is the case. The area of low barometer, which was central over the Great Lakes Jan. 25, barometer 29.7, gathered increased energy when it reached the Atlantic, and off Nantucket the following day the barometer read 29.2; and in the Gulf of Newfoundland, on the 27th and 28th, it read as low as 28.6. The cold, dry, north-westerly winds in the western quadrants of this cyclone, and the warm, moist air flowing into the eastern quadrants, mingled to the southward of the storm-centre, and gave rise to the conditions most favorable to the development of tornadoes on land and water-spouts at sea. Accordingly, Captain Haskell, British bark 'Shetland,' reports that on the 26th, in latitude 39° 34′ north, longitude 71° 16′ west (a little to the southward of the storm-centre), he saw a large spout; the following day (latitude 39° 12′ north, longitude 70° 44′ west) he saw several more; and on the 28th, still more. Captain Garvin, British steamship 'Orinoco,' reports that on the 27th, when entering the Gulf Stream from the north, in about latitude 37° 20′ north, longitude 70° 40′ west, the sea was covered with thick vapor from five to fifteen feet high. The heavy, low-lying clouds seemed to draw the vapor up, and many water-spouts were formed, both large and small; temperature of the water, 60° F.; air, 40°. Captain Cleary, British steamship 'River Avon,' states that on the 28th, in latitude 39° 30′ north, longitude 57° 20′ west, he saw what he took to be a heavy squall to the south-east. Upon looking at it with his glass, he saw that it was a whirlwind, raising the water to a great height. It must have been over a mile in diameter, but he hesitates to even estimate the height to which the water was raised, or the size of the spout, although it must have had terrific power. Shortly afterwards a smaller one passed close to the ship, whirling along the water, and raising the spray to a height of fully a hundred feet. Even as far south as Bermuda the conditions were the same, for on the 27th a whirlwind swept across the parishes of Southampton and Warwick, unroofing houses, blowing down trees, and damaging property generally.

"Similarly, two cyclonic storms, which seem to have originated about the Bermudas on the 10th and 12th of February, as indicated in the weather review published on the March Pilot Chart, were attended by water-spouts, at least one of which was disastrous to shipping. Feb. 10, at 9 A.M., Captain Smith, British steamship 'Ethelbald,' in latitude 28° 18′ north, longitude 74° 06′ west, reports a large spout travelling in a north-easterly direction, rotating, apparently, with the hands of a watch. The barometer was rising; fresh, variable winds, mostly southerly, and sky overcast, with very heavy rain. At this time the American bark 'Reindeer,' Captain Strandt, was about two hundred miles to the westward of the 'Ethelbald,' running up the coast towards New York, in the Gulf Stream. On the 11th the weather became squally, with light southerly winds; and at 10.30 A.M., in latitude 32° 04′ north, longitude 76° 06′ west, when the vessel was under full sail, a heavy

water-spout passed over her, completely dismasting her below the heads of the three lower masts. No previous warning was received; the weather was apparently clear at the time; and the whole affair was over in a few minutes. The dismasted vessel reached Bermuda on the 16th. Again, when the second of these two cyclonic storms was central about latitude 39° north, longitude 67° west, Captain Hogan, British schooner 'Alma,' passed within two miles of a large spout which was travelling from west to east. This was very unsettled weather; wind mostly from the south-westward, but often falling calm and flying to the opposite point of the compass, where it soon died out; thunder and very vivid lightning all around the horizon, but most marked to the north-west and north-east. On the 13th (34° north, 75° west), calm and light variable airs, followed by a breeze from north-north-east, which by midnight increased to a whole gale. Similarly, Captain Paine, American barkentine 'Henry Warner,' reports that during Jan. 21, 22,

at 2 P.M., Feb. 14, latitude 30° 40′ north, longitude 73° 50′ west, and it was blowing a gale from north-north-west at the time. The meteorological conditions prevalent about this time between the Bermudas and the Atlantic coast of the United States are well illustrated by a report made by Mr. Lund, British steamship 'Rothiemay,' Captain Olsen. This vessel arrived at Philadelphia Feb. 20, from Montevideo. From Feb. 1 (latitude 19° north, longitude 58° west) to 9 (27° north, 73° west), fine, pleasant weather, with occasional showers; light to fresh breezes from south-eastward. From the 9th to the 14th (34° north, 74° west), rainy and and 23, off the coast of New Jersey, he encountered light airs going around the compass two or three times every twenty-four hours, exhibiting this same tendency towards the formation of incipient whirlwinds and water-spouts, indicative oftentimes of the gradual generation of a great cyclonic storm.

"A still later report, and one of the best and most detailed which has recently been received, relates to a spout sighted by Captain Battle, American schooner 'Ethel A. Merritt.' This was on Feb. 18, latitude 24° 02′ north, longitude 81° 14′ west, in the Gulf Stream, off Key West, about midway between the Florida Keys

and the coast of Cuba, — only a week after the 'Reindeer' had been dismasted about five hundred miles to the north-eastward. There was a light breeze from the north-east at the time, and the sky was about half covered with nimbus clouds, moving slowly. Just after a light squall had passed by, the first appearance of a water-spout was indicated by the formation of a whirlwind, gradually increasing in size. It was cylindrical in shape below, spreading out above, and rotating in a direction with the hands of a watch. When within about a hundred yards of the vessel, its angular altitude was about 35°, which would indicate a height of only two hundred and fifty feet or less. It was moving to the south-west at the rate of about eight miles an hour. At the base it was transparent; and descending currents seemed to be plainly visible, causing the water at the surface to fly in all directions. A heavy shower of rain accompanied the spout, and the phenomena lasted, in all, about ten minutes.

"Although the study of such reports has already greatly increased our knowledge of the origin and nature of these interesting and often destructive phenomena, much yet remains to be done before we can hope to be able fully to understand the laws by which they are governed. That portion of the North Atlantic from the northern coast of Cuba to the 40th parallel, and from the Atlantic coast of the United States to the Bermudas, is pre-eminently a region where water-spouts are liable to occur, owing largely to the warm, moist air which hangs over the Gulf Stream, and the cool, dry air brought over it by the north-westerly winds from off the coast.

"Among desirable observations to be made, referring to water-spouts, special attention is called to the temperature of the air and water, the reading of the barometer, direction and force of the wind, and the changes which take place in each while the spout lasts; also the direction of rotation of the whirl, and an estimate of its size, character, and changes of form, with, if possible, sketches, however rough, of its appearance at the various stages of its formation and progress."

SCIENTIFIC NEWS IN WASHINGTON.

The Flow of Solids: Solids are not liquefied by Pressure. — The Law of Probabilities: a Discussion of the Doctrine of Philosophical Necessity. — Dynamite Shells: the Progress made by the Ordnance Department of the Army with Experiments with Nitro-Glycerine.

The Flow of Solids.

Mr. WILLIAM HALLOCK of the United States Geological Survey, whose paper upon a new method of making alloys was presented to the Philosophical Society a few weeks ago, read another address upon a somewhat related subject at the meeting of the same body March 17. The question whether solids, he said in substance, possessed any of the properties of liquids, or what conditions will impart such properties to them, is one of ever-increasing importance, to the student alike of molecular physics in general, or of the earth's crust in particular.

The temperature rises as we penetrate the earth: hence, if no other influence affect the substances, the earth has a liquid centre with a thin solid crust. Astronomical and mechanical facts seem to demand a considerable rigidity. Thomson has even demanded a rigidity equal to that of glass or steel. Geological phenomena require a considerable liquid-like motion. With rising temperature, as we penetrate the earth's crust, we also have rising pressure, which probably increases the rigidity of the materials. Cannot we satisfy the demands of both geology and astronomy, and also of mechanics?

In the glaciers we have the grandest examples of the flow of solids. Henri Tresca proved that lead and some other substances would flow, and follow the laws of flowing liquids. W. Spring has extended the list. Monsson actually liquefied ice by pressure. These observations have led many to advocate the idea of a liquefaction by pressure. Others having in view the results of Bunsen, Hopkins, Amazat, and others, maintain that the melting-point is raised by pressure.

Solids can be made to flow: hence that property cannot be used to distinguish solids from liquids. The essential difference between a solid and a liquid is that the relative ease of re-arrangement of the molecules in liquids is very easy, in solids very difficult. Rigidity may be briefly defined as the difficulty of re-arranging the molecules of the body in question. Can rigidity be reduced by pressure? *A priori*, it seems scarcely likely that forcing the molecules nearer together can give them greater freedom of motion. Generally rigidity is inversely as the intermolecular distances. Ice is abnormal, and cannot be taken as evidence *pro* or *con*. Lead, copper, iron, steel, are all hardened by compression. All metals are harder, more rigid, in the drawn, rolled, or hammered state than cast or annealed. The rigidity of a steel pin was raised from 95,000 to 110,000 pounds per square inch by pressure.

Two experiments were described bearing directly upon the question, and are convincing, although they gave unwelcome results to those who made them. The first was conducted under the direction of the Ordnance Department, and is given in full in the report on 'Tests of Metals, etc., for 1884,' pp. 252–285. A mixture of four parts wax and one part tallow was used as a 'straining liquid' in 'tangential' test. It was demonstrated that that mixture would not transmit pressure through a hole $\frac{3}{16}$ of an inch in diameter and $2\frac{1}{2}$ inches long, when the pressure at one end was 100,000 pounds per square inch, and at the other 30,000 pounds per square inch, or less; whereas 2,000 pounds was sufficient to overcome all friction, and force it through, when there was no back pressure: that is, the wax and tallow were rigid enough, under pressure, to maintain a difference of 70,000 pounds per square inch (100,000—30,000) at the two ends of that hole.

The second experiment was also made with the testing-machine of the Ordnance Department at Watertown, Mass. (see *American Journal of Science*, iii. 34, 1887, p. 280). In that experiment silver coins on top of paraffine and beeswax in the holder, instead of sinking through a liquid under 6,000 atmospheres, were pressed so hard against the top of the holder that their impression in the steel was easily seen and felt. The paraffine and wax were rigid enough to impress silver into steel.

Such facts lead us to believe that pressure increases rigidity; and, when we remember that the pressure at the centre of the earth is millions of atmospheres, a demand for the rigidity of steel seems trifling. What is the rigidity of steel? Simply a rigidity capable of resisting 30,000 to 100,000 pounds per square inch. But distinguished geologists have made the fatal mistake of using 'the rigidity of steel' and 'absolute rigidity' as synonymous and equivalent terms. Nothing is more misleading.

Upheavals and depressions, and other geological phenomena, are most beautiful examples of viscous flow of solids. The forces causing a glacier to flow are trifling as compared with those generated in the earth's crust by shrinking; and undoubtedly to cause any body to flow, we only need sufficient force and time.

Can pressure impart to solids the ability to change crystallographically, mineralogically, chemically? Prismatic sulphur naturally changes to octahedral, and in many other cases changes take place under ordinary conditions of pressure and temperature. We should scarcely expect pressure pure and simple to cause a re-orientation of the axes of the two crystal fragments, even if it could perfectly weld them together. Nor should we expect pressure, without heat, to impart the ability to complete the fusion of a lump of barium sulphate in sodium carbonate, even after the process had been well started by heat. Under the extremely complex conditions, it is difficult to generalize. A welding-together is not only theoretically but practically possible between two chemically clean surfaces that fit, but any operation which requires an increase of freedom in the molecules would scarcely be assisted by pressure. Cohesion and adhesion I believe to be identical, and molecular rather than molar.

The bearing of these ideas, if good, upon geological phenomena, is somewhat thus: by the action of pressure and time we might find a sandstone, or such material, compacted, and rendered coherent or even continuous, the most plastic constituents yielding most, and the most viscous retaining their shape most perfectly. Some constituents might even appear to have been fused and filled in between the rest. Certain crystallographic changes might take place, but more than the slightest chemical effect of the constituents upon each other is not to be expected. The case becomes infinitely complex, and a subject for conjecture only, if the temperature is high. An indisputable fact in this connection is that

many more experiments are needed, and that they should be of such a character that each effect can be ascribed to its proper cause, and that causes and effects shall not be treated collectively, as at present.

On Probabilities.

A year ago, or more, Mr. M. H. Doolittle presented a paper to the Mathematical Section of the Philosophical Society, on the doctrine of probabilities. It gave rise to an interesting discussion at the time, which led him, at the last meeting of the section, to return to the consideration of the subject. Referring to an important change of opinion by John Stuart Mill, as shown in the eighth edition of his 'System of Logic,' and set forth in the introductory paragraphs of the chapter on 'The Calculation of Chances,' Mr. Doolittle showed that the two antagonistic schools started with two different definitions of the doctrine of chances, — one, to which he belongs, accepting the latest definition by Mill, which he adopts from Laplace; and the other, that given by Mill in the first edition of his 'Logic.'

"Probability," says Laplace, "has reference partly to our ignorance, partly to our knowledge. We know that among three or more events, one, and only one, must happen; but there is nothing leading us to believe that any one of them will happen rather than the other. In this state of indecision it is impossible for us to pronounce with certainty on their occurrence. It is, however, probable that any one of these events, selected at pleasure, will not take place; because we perceive several cases, all equally possible, which exclude its occurrence, and only one which favors it."

"To a calculation of chances, then," says Mill, "according to Laplace, two things are necessary: we know that of several events some one will certainly happen, and no more than one; and we must not know, or have any reason to expect, that it will be one of these events rather than another." Mr. Mill then expounds the doctrine formerly held by himself, to the effect that these are not the only requisites, and that Laplace has overlooked, in the general theoretical statement, a necessary part of foundation of the doctrine of chances, — the knowledge that one or the other of the events must happen, but the possession of no grounds for conjecturing which. "We must remember," explains Mill, "that the probability of an event is not a quality of the event itself, but a mere name for the degree of ground which we or some one else have for expecting it."

Having read these passages, Mr. Doolittle took up briefly the discussion of the doctrine of philosophical necessity, and referred to Edwards on 'The Freedom of the Will' as exceedingly able in the presentation of this doctrine, and one of the first, if not the very first, American book that became famous throughout the world. On the other side, he quoted from Adam Clarke's 'Commentary on the Bible' as one of the ablest opponents of philosophical necessity. Dr. Clarke's argument is, that, since there are events in the future which are uncertain, it is impossible for them to be known as certain, so that divine foreknowledge is only a knowledge of probabilities, and does not include the certain knowledge of uncertain things. Mr. Doolittle then asked his audience whether, whatever they might think of Adam Clarke's Deity, any one would claim to be a Deity of that sort himself, and argued, that, in any case, it is proper for us to base our theory of probability on human intellectual conditions, and not on divine intellectual conditions. He then said that the doctrine of probability is not peculiar in this respect. Metaphysicians say that all our knowledge is based upon our states of consciousness. We know only our states of consciousness, and although we cannot say that any probabilities exist in the nature of things, still we may presume that probabilities having a scientific basis, have in some manner their counterparts in the external world, just as we presume that other states of consciousness have their counterparts in the external world.

With regard to such probabilities, Mr. Doolittle said Mill was right in his first edition. But there still are probabilities of less scientific character that may nevertheless be made the subject of mathematical computation.

This paper was discussed for an hour by leading members of the section. Professor Harkness of the Naval Observatory accepted the definition of probabilities given by Mill in his first edition, as did also several other gentlemen connected with that institution. The gentlemen connected with the Coast Survey, on the other hand, generally accepted Mill's latest definition adopted from Laplace.

Dynamite Guns.

Among the appendixes to the 'Annual Report of the Chief of Ordnance,' soon to be published, is one prepared by Maj. George W. McKee, on 'The Present Status of Dynamite as an Explosive for Shells.' Prefacing it with a brief history of the discovery and use of nitro-glycerine, he says, —

"The Nobel's explosive gelatine, or blasting dynamite, has been used in this country by United States officers to the entire demonstration of the fact that this high explosive, contained in a shell as a bursting charge, might be fired from a gun. The ordinary blasting dynamite made by the company (some of it experimentally modified with about 3 per cent of camphor) was used, and enough shells were thrown from the bores of the old mutilated guns used in the experiment to demonstrate the fact that dynamite could be projected in shells from an 8-inch rifle gun with a 40-pound charge of powder. The great chemist Nobel never, perhaps, thought of applying his invention to this delicate test; but his powerful and wonderful gelatine, made only to be detonated in mines and the like, stood in several instances the tremendous initial shock of the gunpowder, and, by the aid of the rectangular diaphragms devised by Captain Whipple of the Ordnance Department, stood, what is thought to be equally dangerous, the heat developed by the angular velocity. If the gelatine had been especially undertaken by these chemists for a military and not an industrial agent, and enough time and means had been at hand to perfect the diaphragm, it is believed all of the shells would then have become, as they will be in future, high-explosive batteries, projected with as much safety as though they had been charged with black gunpowder."

Major McKee, in reviewing various experiments that have been conducted under the direction of the Ordnance Department, speaks of them as follows. Of the method exhibited by Mr. Snyder, he says, "He did fairly well with some of his firing at the Hook and on the Potomac, near Washington, D.C., and, as he is a man of inventive talent and an American, no one wishes him more success in his future experiments with dynamite than the men who were delegated by the government to supervise and report upon those he originally undertook." In the experiments with shells loaded with dynamite, conducted by Brevet Brig.-Gen. John C. Kelton, at Point Lobos, near San Francisco, Cal., in March, 1885, no specially camphorated or otherwise prepared explosive was used, but the shells were charged with the crude, blasting, industrial dynamite. Three rounds were fired from a 3-inch wrought-iron rifled gun, — shells with two hundred grams of dynamite, and a variable charge of projection. The target was a large rock at 157 yards distance. In the first two rounds the shell burst into innumerable pieces on striking the rock, but in the third it burst within the piece. Colonel Kelton considered this experiment as very satisfactory, since it demonstrated the possibility of employing dynamite in shells, as well as the great strength of this great explosive; and he estimates that for the effective use of these artifices, which, according to him, is to destroy ships, one-half the length of the projectile is the penetration needed, requiring 0.001 of a second, and he expects it will be successful.

After describing some experiments at Sandy Hook in 1883, Major McKee sums up the results as follows: —

"As detailed in the records, three shells were fired with fulminate-of-mercury fuzes. The fulminate was too sensitive to stand the shock, and it was found afterwards that the gelatine needed no detonator.

"Although the tests made were very few, it would nevertheless appear from them —

"(1) That the shells explode after clearing the muzzle, and therefore the detonation of the gelatine is due to some cause other than the shock of discharge, very possibly the heat generated by angular velocity.

"(2) This is corroborated by the fact that one shell passed through a 2-inch board target without explosion.

"(3) The gelatine used in these tests, not being camphorated, renders it highly probable that a certain percentage of camphor

added would establish a compound which could be fired successfully in a specially constructed shell.

"(4) The gelatine does not require a fuze or detonator of any kind.

"(5) It is believed the shell which destroyed the 3.2-inch breech-loading gun broke from the shock of discharge, or admission of powder-gas, and thus detonated the gelatine."

In the summer of 1884 the Ordnance Board fired four cast-iron screw shells from an 8-inch muzzle-loading rifle, using forty pounds of powder in the gun, and from five to eight pounds of gelatine in the shells, at each discharge. The gun was mounted on a cradle, and directed at a target 383 feet distant. One of the shells burst at or near the muzzle with little comparative violence. The other three reached the target, penetrated about seven inches, and detonated from the shock. These trials led to the making of six steel shells, three of them being cast, and three forged. Analysis of the facts connected with these experiments shows —

"(1) That the 3-inch shells designed for gunpowder charge, when loaded with Hill's explosive gelatine, three months old, all cleared the gun without injuring it in the slightest.

"(2) That the shells, having to be charged through the fuze-holes with the dynamite, were necessarily packed loosely, thus subjecting the charge to the powerful action of angular velocity.

"(3) That in the trials made with the 3.2-inch gun, two Butler shells, charged with black gunpowder, broke up 'at or near the muzzle;' while of the two Butler shells charged with Nobel's gelatine, or dynamite, one broke up 'at or near the muzzle,' and the other reached the target and exploded on impact.

"(4) That in the trials made with the same 3.2-inch gun, using thin Hotchkiss shrapnel cases, charged with Nobel's dynamite or gelatine, all cleared the gun in safety (one reaching the target after passing through two-inch boards) with the exception of one, which the board reported on as follows: 'It either broke from the shock of discharge or admitted powder-gas.'

"(5) That *all* the trials with the 8-inch shells charged with *fresh* Nobel's dynamite or gelatine were successful, three of the shells detonating at the target, and one only exploding at or near the muzzle; that the gelatine used when the premature explosion took place was sixteen months on hand in this country after crossing the ocean, and therefore not such as was recommended by General Abbot, or contemplated by the board."

Major McKee's conclusions are as follows: that the United States officers undertaking the investigation of this subject were necessarily compelled to institute their inquiries *de novo*. All foreign information was so meagre, so unsatisfactory, and so shrouded in mystery, in accordance, doubtless, with the policy of the European governments, that it was seen, after careful investigation, that all trustworthy knowledge would have to be gleaned by Americans through experience. In obtaining this experience, devices have been experimented with, invented by Mr. Snyder, who presented several plans; Mr. C. P. Winslow, with a nitro-glycerine shell, in which the glycerine and combined nitric and sulphuric acids are placed in separate glass vessels within the shells; Mr. Garrick, with a mortar and projectile for nitro-glycerine; Mr. D. P. Hill, with an 8-inch explosive gelatine shell; Mr. Stevens, with a double shell for high explosives; Mr. Graydon, with a shell containing the dynamite in capsules; Mr. Taylor, who brought his own gun, and attempted to use dynamite as a propulsive charge; and Mr. Smolianoff, experiments with whose gun were made as late as last October.

In all these trials, Major McKee said, as to the practicability of using dynamite as a shell-explosive, that it was well understood by the officers undertaking them that the crude blasting compound of industry, which was the only available explosive attainable, was not the eventual product of chemistry which would satisfactorily answer this purpose. It was known that great improvements had been made in the dynamites of all kinds, especially in blasting dynamite, or gelatine of Nobel, and that these compounds presented in transportation by all modern conveyances, and in all mining and other industrial works, as much, if not greater, safety than the black war, sporting, and blasting gunpowders of commerce. With this status of dynamite apparent, it was seen that the time had arrived for military men in the United States to begin experiments with it as a shell-explosive, with some possibility of success. When it was demonstrated that the freshly prepared crude commercial dynamite might be fired in a shell from an 8-inch gun with a charge of forty pounds of black gunpowder, the only question that then remained was as to the stability and reliability of the compound through age. And when, after sixteen months' storage, it appeared to be more sensitive to shock, the Ordnance Board recommended that no more experiments be made with it until it was further camphorated, or otherwise treated by competent chemists. And it was ascertained further, in these few and inexpensive tests, that the heat developed by the angular velocity was a more potent factor in detonating the dynamite than was the shock of discharge. It has been seen, also, that, since the comparatively recent discovery of nitro-glycerine, its development has been rapid in the protean forms of dynamite. In Europe experiments are being constantly conducted to perfect this agent, and doubtless they will succeed. Even now they claim in France and Germany to have perfected melinite and helphonite, — compounds probably of nitro-glycerine and some of the ethers. In Russia they also announce some new improvements that are not known here. But in the near future there is every probability that the problem will be solved in this country.

ELECTRICAL SCIENCE.

Electrical Testing-Laboratories in Paris and Vienna.

THE Société Internationale des Electriciens has completed and opened a laboratory whose main purpose will, for the present, be the testing and calibrating of electrical apparatus. M. de Nevville will be the director. The following measurements will be made: resistance, capacity, electro-motive force, constants of batteries, of cables and wires, insulation resistance, efficiency of dynamos (provisionally of continuous-current machines), and co-efficients of induction. When the means allow, purely scientific researches will be carried on. The laboratory is built on a modest scale, and seems to lack a few pieces of apparatus that will probably be supplied: for example, there is no provision for measuring mechanical work, — a measurement necessary in many cases for the tests of dynamos and motors.

The laboratory in Vienna is an addition to the Technological Museum in that city. Herr Carl Schlenk will superintend the work, which will include very much the same kind of tests as are to be made in the Paris laboratory.

The establishment of these two laboratories is important. The applications of electricity have rapidly advanced, and have assumed a permanent character. The questions in many cases are not, 'Can electricity do this?' but, 'How cheaply can it be done?' and this last question can only be answered by measurements. As competition increases, and as that part of the public looking for investment becomes less satisfied with the mere running of a machine, and demands accurate measurement of its performance, the necessity of some reliable means of comparing measuring-instruments becomes necessary. In England the Central Institution of London has undertaken the work; in Austria, the Technological Museum at Vienna; in France, the International Society of Electricians. Our country has outstripped all others in the applications of electricity. Probably we will soon have some means of comparing electrical apparatus, and testing the value of the numerous appliances daily patented. Electrical progress has been retarded and discredited by worthless patents in which a great deal of money has been invested and lost, while a simple test, taking little time and made at little expense, would have shown them valueless.

DUJARDIN'S METHOD OF FORMING SECONDARY-BATTERY PLATES. — Several methods have been tried, and some are now commercially used, of obtaining a quick formation of 'active material' — peroxide of lead and spongy lead — for secondary-battery plates. The Planté process of reversing the current is employed by some makers, while others deposit the peroxide and lead on support plates from an alkaline solution of litharge, as in the Moutard batteries. Dujardin's process of obtaining a deposit is as follows: the lead plates are put into a solution of sulphuric acid and sodium nitrate in water (10 of water, 2 of sulphuric acid, 1 of sodium or potassium nitrate), and a current is sent through the cell. By the passage of the current, nitrate of lead is formed, the lead

being dissolved from the positive plate; and this is changed into sulphate of lead, and afterwards by the current into peroxide of lead. In a few hours the plate is covered with a layer of crystalline peroxide of lead. During the formation, air is forced through the cell, or the plates are lifted from the liquid at intervals. In the absence of data as to the performance of plates formed in this way, it is impossible to compare them with the ordinary 'grid' plates, pasted with red lead by the Faure process. The disadvantages of this last form have been pointed out in a previous number. The type of cell under which that of M. Dujardin comes — the 'Planté' form — generally offers the advantage of quicker discharge rate, and freedom from 'buckling,' as against the greater storage-capacity of the Faure type. How far M. Dujardin has remedied the difficulties of the type outside of the time necessary for formation, remains to be seen.

DISCUSSION OF ALTERNATING-CURRENT TRANSFORMERS. — The papers of Messrs. Kapp and Mackenzie before the English Society of Telegraph Engineers and Electricians have excited a great deal of interest and discussion on the subject of alternating currents. A number of people, many of them directly interested in electric lighting, have spoken on the matter. The majority of the speakers seemed in favor of the system, although it was attacked by Messrs. Gordon and Crompton, who prefer using storage-batteries for distribution. Arguments in favor of the alternating-current system were drawn from the experience of the Westinghouse Company in the States, that would be more weighty on this side of the ocean, if they were known to have been carefully verified. Some results of tests of the efficiency of transformers were given by Professor Ayrton, — the method of testing having been borrowed from our side of the water, — and values of 96 per cent were obtained under the most favorable conditions. As has been pointed out, however, in a former number of this journal, the transformers only work at the maximum efficiency for a short time during the day, so that the average efficiency will not probably be above 80 per cent. Various speakers favored different systems of distribution, but there were very few who had no experience to give; and the discussion was an interesting and instructive one.

BOOK-REVIEWS.

Transactions of the Association of American Physicians. Second session, held at Washington, D.C., June 2 and 3, 1887. Philadelphia, Assoc. Amer. Phys.

THE Transactions of the Association of American Physicians at their second annual meeting in Washington has been published. This association is without doubt the most representative body of the medical profession of the United States, having on its roll of membership the most prominent physicians of the country. The papers which are contained in this volume are of a very high order, and the discussions are exceedingly pointed and valuable.

The treatment of consumption by Bergeon's method, that is, by gaseous enemata, was the subject of three of the seventeen papers, the authors being Edward T. Bruen, M.D.; F. C. Shattuck, M.D., and Henry Jackson, M.D.; and William Pepper, M.D., LL.D., and J. P. C. Griffith, M.D.

Dr. Bruen sums up his views in these words: "I incline to think that suitable climatic environment is an all-important adjunct to the proper settlement of the value of Bergeon's treatment. But it is certainly an important addition to our therapeutic equipment to have an agent capable of influencing very markedly bronchial catarrh in so many cases, especially the 'stay-at-homes.' In a word, Bergeon's method, so far as I have used it, is chiefly valuable in those cases of pulmonary disease attended with bronchial catarrh. But I fear the trouble and detail necessary to its successful use will prevent many from employing the method, and I can easily see that the limitation of the power of Bergeon's method will cause it often to be set aside for other plans of treatment."

Drs. Shattuck and Jackson say, "This method is in no sense a specific for phthisis. If useful, it is only as auxiliary to older and generally accepted methods. The only benefit which we saw in our cases that can fairly be attributed to the enemata was diminution in the amount of the expectoration. The good effects which have unquestionably followed the treatment on this side of the water, as well as in France, are perhaps largely attributable to the stimulus afforded by a novel method of treatment, which is of such a nature that the patient cannot but feel that not only something, but much, is being done for him."

Drs. Pepper and Griffith conclude as follows: "Our conclusions, so far as they can be formulated in a preliminary report of comparatively few cases, are, that the treatment of phthisis by gaseous enemata has had very undue value attributed to it; that it is seldom of any real benefit, but that it may prove serviceable in occasional cases."

Dr. Henry Hun presented a paper on sewer-gas poisoning, with a history of twenty-nine cases. He concludes that it is probable that the following conditions may result from poisoning by sewer-gas: 1. Vomiting and purging, either separately or combined; 2. A form of nephritis; 3. General debility, in some cases of which the heart is especially involved; 4. Fever, which is frequently accompanied by chills; 5. Sore throat, which is frequently of a diphtheritic character; 6. Neuralgia; 7. Perhaps also myelitis of the anterior horns; 8. Zymotic diseases, such as typhoid-fever, pneumonia, diphtheria, cholera, dysentery, cerebro-spinal meningitis, erysipelas, and scarlet-fever (in these cases, undoubtedly, the sewer-gas merely acts as a vehicle for the specific germs); 9. A condition of asphyxia, which in its severe form is characterized by coma, convulsions, and collapse; 10. Puerperal fever; 11. Abscesses; 12. Lymphadenitis; 13. Acute aural catarrh (?).

The only other paper read at the meeting, which was of general interest, was one on methods of research in medical literature, by John S. Billings, M.D., U.S.A. This paper contains a good deal of excellent advice to physicians who desire to read up on any particular subject for the preparation of articles for publication or presentation to medical societies. Dr. Billings thinks that one of the most useful pieces of work which could now be undertaken for the benefit of medical writers and investigators would be the preparation of a dictionary of critical bibliography of medical bibliography, in which should be indicated for each subject, in alphabetical order, a reference to where the best bibliography relating to that subject can be found. This could only be well done by a co-operation of a number of writers, each taking a special field. This useful paper of Dr. Billings closes with a list of forty of the most useful reference-books, commencing with Albertus Haller's 'Bibliotheca Botanica' (1751), and ending with Richard Neale's 'First Appendix to the Medical Digest' (1886).

The other papers which were presented to the association were purely medical, and of little general interest.

Sewage Treatment, Purification and Utilization. A Practical Manual for the Use of Corporations, Local Boards, Medical Officers of Health, Inspectors of Nuisances, Chemists, Manufacturers, Riparian Owners, Engineers, and Rate-Payers. By J. W. SLATER, F.E.S. New York, Van Nostrand. 8°.

THIS octavo of 271 pages is one of the Specialists' Series, of which a number of treatises have already been issued, and of which several more are now in preparation. The title of the book before us is, we think, a little misleading. The reader expects from such a comprehensive title a good deal more than he actually finds when he reads the book. Still, the subjects which the author treats are handled in a very interesting and decidedly original manner, and, when the book has been read through, the reader is surprised that so much has been put into so small a space. Its perusal impresses one with the idea that Mr. Slater is a practical man, and that he writes of that which he knows from personal experience and observation, and not from a closet study of the books of others.

In his preface he refers to the unsettled state of the sewage question. Freezing and heating, concentration and dilution, electrization and magnetizing, the addition of oxidizers and deoxidizers, of ferments and preventives of fermentation recommended, if not actually tried, show the want of any distinct and generally recognized principle. This is still more forcibly illustrated by the fact that since 1846 there have been no less than 454 patents issued for the chemical treatment of sewage. In the space at our disposal it will be impossible to follow the author in detail; but there are some points

which he brings out more clearly than any other writer with whose works we are familiar, and to those we desire to call attention.

In speaking of the London system, he pronounces it a failure. This system he calls Bazalgettism, from the distinguished engineer who has applied it to London. Its essential principle is to discharge either directly into an arm of the sea, or into a tidal river, at the time of ebb-tide. Sewage matters discharged into the river at Barking and Crossness are not pushed out to sea by the combined action of the ebbing tide and current, as was expected, but mingle with the water, and work their way back to points far above the outfalls, thus effecting that pollution which the intercepting sewers and the costly channels running parallel to the river were to have averted. Mr. Slater summarizes the matter as follows: "The Bazalgette process, as applied to London, is a total failure. It involves the utter waste of all the manurial matters in the sewage, it aids in silting up the bed of the Thames, it occasions a nuisance much complained of by the inhabitants of the country below the outfalls on both banks, its cost is exceedingly serious, and it does not even guarantee to the inhabitants of London an unpolluted river." It would be hard to conceive of a more vigorous and thorough condemnation than this which Mr. Slater applies to the sewerage system of London, and he is equally emphatic in reference to the proposed extension of the system to Thames Haven at an expense of $20,000,000.

The disposal of sewage by irrigation meets with no better treatment at his hands. He asks, "Does irrigation effect its object without occasioning annoyance or injury to the inhabitants of the district?" He has never failed to detect an unpleasant odor when passing near an irrigation-field in warm, still weather. At Gennevilliers, near Paris, the odor on calm, autumnal evenings may, without exaggeration, be described as abominable. Mr. Slater also believes that irrigation-fields may produce actual disease in their neighborhood, although he acknowledges that the evidence is somewhat conflicting. Irrigation does not remove germs, and it encourages flies, which act as carriers of these germs, it may be of cholera or typhoid-fever. On this danger from flies the author is very emphatic. He says that some of these insects that have become saturated with putrescent matter, or actual disease-germs, enter our houses and crawl over articles of food. Others settle upon our persons, and inflict malignant wounds. Fatal illness has not unfrequently been traced to the bite of flies which feed on sewage or carrion. These flies being now recognized as among the greatest agents for carrying putrid poisons and disease-germs to the healthy, it is important that all places where they can increase and multiply, and all matters upon which they may feed, should be made offensive to them or destroyed, as the case may admit.

These opinions are sustained by the experiments of Dr. Maddox, published in the *Journal of the Royal Microscopical Society*, by which it was demonstrated that the cholera bacillus can pass in a living state through the digestive organs of flies, and also by the experiment of Dr. Grassi, who showed that when segments of the tape-worm (*Taenia solium*) were placed in water, some of the eggs remained suspended therein, and that in the intestines and excrement of flies that drank of the fluid the eggs were subsequently found. Observations made by other experimenters are also confirmatory of the fact that insects act as carriers of germs and ova of parasites. Mr. Slater believes, too, that sewage-grass is very inferior to normal herbage, and quotes experiments made by Mr. Smee, and published by him in a work entitled 'Milk in Health and Disease,' by which it was proven that milk from cows fed on irrigation-grass became sour and underwent putrefaction much sooner than that from cows fed on grass from an ordinary meadow.

In concluding the discussion of irrigation, the author says that irrigation, though an excellent method of disposing of, and at the same time utilizing sewage, when suitable land is available, where the climate is warm, and the rainfall scanty or intermittent, is not applicable where these conditions are absent. Any attempt to represent it as the only means of dealing with the sewage difficulty, and to force it upon reluctant communities, is a grave error; in fact, a crime, the motives for which are in most cases hard to trace. The methods of sewage-disposal by filtration, precipitation, destruction, distillation, and freezing, are described, and their advantages and disadvantages pointed out.

The author, in concluding his treatise, devotes more than sixty pages to giving an abstract of the specifications of the 454 patents for the chemical treatment of sewage, occasionally adding a note pointing out what he considers to be their defects.

Letters of David Ricardo to Thomas Robert Malthus. Ed. by JAMES BONAR. Oxford, Clarendon Pr. 8°. $2.75.

THE letters in this collection were written between 1810 and 1823, the last of the series being dated only a few days before the writer's death. They are only in a minor degree personal, being mainly devoted to discussing the many questions in political economy on which Ricardo and Malthus disagreed. Unfortunately, the letters that Malthus wrote to Ricardo have never been found; so that we have only one side of the discussion, which is a drawback both to the interest and to the instructiveness of the correspondence. It is true that Ricardo often states his opponent's arguments; but such statements cannot supply the place of Malthus' own words. However, the letters will be very interesting to students of economics, illustrating as they do the views of two of the principal founders of the science. The men were personal friends, and were often in each other's company; but on economic themes they differed widely. They agreed in the main on the subjects of rent and population; but they disagreed on many matters of detail and on some of prime importance. Thus, they differed widely as to the definition of value, and as to the influence of supply and demand on the one hand, and of cost of production on the other, in determining value. They also differed as to the real nature of political economy; Malthus holding that it is an inquiry into the nature and causes of wealth, while Ricardo would confine it to the subject of distribution only (p. 175).

The two leading faults in Ricardo's published works appear with equal plainness in these letters. The first of these is his habit of fixing on one or two economic laws or forces, and tracing out their results without regard to the minor influences which often modify their action. He seems to have been aware himself of this tendency in his thinking; for he remarks in one of his letters that one of the chief causes of the differences between himself and Malthus was that he looked only to the larger and more permanent causes, while his opponent was always thinking of the minor ones. On this point, as on some others, it would have been well if the two friends had been content to learn from each other. The other defect in Ricardo's theories to which we have alluded is his constant assumption that wages are always at the starvation point, so that the slightest increase in the cost of living will necessitate a rise of wages in order that the supply of labor may be kept up. Thus, he argues that a tax on breadstuffs would lead to a rise in wages, and consequent fall in profits; whereas it might only result in reducing the standard of living among the laborers, so that the whole burden would fall upon them.

The friendship between the two correspondents, notwithstanding their difference of opinion, was of the warmest character, as is proved by many passages in these letters, and also by a remark made by Malthus after Ricardo's death, and quoted at the end of this volume. He said, "I never loved anybody out of my own family so much. Our interchange of opinions was so unreserved, and the object after which we were both inquiring was so entirely the truth and nothing else, that I cannot but think we sooner or later must have agreed." We should add, that the book is well edited, and that it contains much information, both in the text and in the notes, about Ricardo and Malthus themselves, and also about other political economists who lived in their time, so that it has a biographical as well as a scientific interest.

Lectures on Electricity. By GEORGE FORBES. London and New York, Longmans, Green, & Co. 12°. $1.50.

A NUMBER of popular works on electricity have been published in the last few years. Some are clearly written, some are interesting, very few are calculated to give correct ideas of the broad principles of the science of electricity.

There are six lectures in Professor Forbes's book, "intended for an intelligent audience, ignorant of electrical science, but anxious to obtain sufficient knowledge of the subject to be able to follow the progress now being made in the science." For its purpose the book is admirable. The simpler phenomena — if we may consider any

phenomenon as simple — are clearly explained, and illustrated by experiments, sometimes new, always well arranged.

Lectures of this kind should have two objects, — to describe the phenomena, and state and explain the laws governing the science as fully as possible; and to give the audience an interest in the subject, and a curiosity that will lead to a further study of it. They should give an impulse toward thought, with some material for thinking on. So viewed, Professor Forbes has succeeded.

The first five lectures — on potential, electric currents, magnetism, electro-magnetism, and electro-magnetic induction — are extremely satisfactory: the last, on dynamo-electric machinery, would have been better omitted. It does not logically continue what has come before, nor is it, even considered apart from the other lectures, in any way as satisfactory as they are.

Taken as a whole, however, the lectures are to be commended for the clearness of exposition, accuracy of statement, and the very interesting way in which they are written.

NOTES AND NEWS.

A CYPRUS Exploration Fund has been formed in London, the object of which will be to carry on archæological researches similar to those of the Palestine Exploration Fund. The committee of this fund have applied to the high commissioner of Cyprus for permission to excavate in the island. This application was supported by a special resolution addressed to the secretary of state for the Colonies by the trustees of the British Museum. Permission has now been obtained in respect of one site, the village of Kouklia, which stands on the site of the ancient Paphos; and operations have begun there, on a large scale, which promise to yield results of exceptional interest, the special object in view being the great temple of Venus. The work is being carried out by students of the British School at Athens, under the supervision of the director, Mr. Ernest Gardner, whose services, and a contribution of £150, were placed at the disposal of the Cyprus Exploration Fund by the managing committee of the school. The same sum has been contributed respectively by the University of Cambridge (from the Worts Travelling Fund), the University of Oxford, and the Society for the Promotion of Hellenic Studies. Individual subscriptions amounting to upwards of £600 have been received.

— George S. Mackenzie, secretary of the Emin Pacha Relief Committee, publishes the following news, which was sent by mail from Zanzibar: "It is reported in the *Bazaar* here that Tippo-Tip, after some delay, has sent a number of his men to Mr. Stanley's camp on the Aruvimi." This news, which is published with some reserve, is very gratifying, as it shows the desire of Tippo-Tip to carry out the engagements he entered into with Stanley. The arrival of Tippo's party would enable Major Barttelot to despatch without delay the ammunition and reserve stores from the camp of Yambuga, at the mouth of the Aruvimi, to Wadelai. Although Stanley's progress was evidently not as rapid as was assumed in the plan, it is not necessary to entertain serious apprehensions as to the safety of his expedition. When it was stated that news of Stanley would probably reach us early in March, it was assumed that the steamers of the Kongo Association would visit the stations at Aruvimi and Stanley Falls. The steamer 'Stanley' was to be despatched to these places under the command of Captain van der Velde. Unfortunately this able officer died at Leopoldville a few weeks ago, his death being announced in the latest issue of the *Mouvement Géographique*. He explored the lower Obangi and its tributaries, the Itimbiri, and made an unsuccessful attempt to reach the Welle, starting near the most northern point of the great bend of the Kongo. His death has delayed the expedition to Stanley Falls, and for this reason it is assumed that the first news of Stanley will reach us *via* Zanzibar. As, however, communication between the Mvutan Nsige and the coast is very irregular, it is hard to tell when definite and reliable news will reach us.

— On Feb. 17 the first memorial erected to a public man in the Brighton Museum was unveiled there in the shape of a marble medallion portrait of the late distinguished scientist, Dr. Thomas Davidson, the first chairman of the museum committee, and whose lifelong study of brachiopoda won for him a foremost name in the ranks of paleontologists.

LETTERS TO THE EDITOR.

The Snow-Snake and the r-Sound.

THE evidence on the Southern use of the snow-snake is certainly not what was expected, and, with my experience of Indian traditions, is not satisfactory. Passing by this, I will mention two things noticed while on the reservation to-day. Many Seneca snow-snakes are now made there, and these differ from the Onondaga in being flat on the opposite surfaces, with the edges slightly rounded. A good crust being lacking, an enterprising Indian had made a gutter in the snow by the roadside, about fifty rods long, and was getting a little money by its use from a number of boys.

I looked up the name carefully. It had been written for me, as before stated, and I had somewhat hastily asked several its name when last there, without noticing any discrepancy. Now, it appeared that Mr. Hewitt was partially right; but every man, woman, and child gave it as *ka-when-tah*, or *ka-wen-tah*, changing the supposed *r* into *n* uniformly, and sometimes hardening the *k* into *g*. As I paid special attention to the second syllable, my own orthography stands corrected in this case, and that of Mr. Hewitt also. I also corrected one other word in which I made a similar error in some casual work.

In testing the version of the Lord's Prayer given me, a second time, the question is not so clear. I am not in the least troubled with *otosis*, and had used reasonable care, but without regard to the objection now made. The first three instances in which I then retained the letter may be called doubtful. I went over them again with my old friend Albert Cusick, and although the letter seemed there as the words were read, — and perhaps ordinary speech is the true test, — yet the sound almost disappeared when each syllable was taken by itself. In the fourth, where a clause was paraphrased rather than translated, there is less room for uncertainty. The sound is fuller, and is not readily dispensed with. But for its rarity elsewhere, I certainly should retain it there.

The last test I used was with the numerals given by Schoolcraft in his Onondaga vocabulary. He credits some words in it to the Mohawk. I do not remember that he does these, but they are not of the Onondaga language. In the first ten Onondaga numerals, *r* does not occur.

It is evident, of course, that Zeisberger incorporated many Mohawk words in his Onondaga lexicon, and his early study of that tongue perhaps sufficiently accounts for this; but how he could have spent the time he did at Onondaga, for the sole purpose of studying the language, and yet used this letter so much, and even in proper names, without its partial use by the central nation, is not easily understood.

One of the eminent authorities cited for the early disuse of the letter seems merely to quote from another, but some historical facts may have been overlooked. The Jesuit missions at Onondaga were abandoned late in the seventeenth century, though the missionaries sometimes came there very early in the eighteenth. In preparing a list of historic Onondagas, I took notice of a half-century of this *post-Jesuit* period. From 1725 to 1775, I found the names of fifty-seven Onondagas, and twenty-three of these contained the letter *r*. *Teyawarunte*, an Onondaga sachem, was speaker in 1775, as he had been long before. The year previous, the Onondaga sachems had a private audience with the new Indian agent, Col. Guy Johnson, and some of their distinguished men were presented to him. In the names of four out of the eight mentioned, is found the nominally obsolete letter. Here I leave the question.

W. M. BEAUCHAMP.

Baldwinsville, N.Y., March 8.

Needed — An Improved Means of attaching Microscopical Objectives.

THE recent interesting discussion in *Science* regarding the defects of existing microscopes ought to lead to practical results. While the subject is under consideration, every detail ought to be passed under review, or rather studied *de novo*, accepting no legacies of the past, no matter how useful they may have been in their day, provided we can find better devices. One very important thing to be considered is the means whereby objectives are to be attached to the tube of the microscope. Obviously, what we need for this purpose is a device so simple it can be easily manufactured and

used, — one that is durable, and not liable to get out of order; which will fix the objective firmly in position, and yet will permit it to be attached or removed with the least possible expenditure of time and energy. It must be admitted that the screw meets all these requirements except in the important matter of attaching and removing the objective. The screw is not an expeditious mode of attachment, although it may be improved by lessening the number of the threads so that only one or two turns of the objective tube would be needed in order to bring it to position. Most objects require to be studied under different amplifications, and the time spent in changing from one to another is a real loss. Most working microscopists will begrudge every second spent in changing, not only because their time is valuable, but also because an object may thus be lost, at least for a time, especially if it is a moving object. If it is possible, objectives should be attachable and removable without having to draw back the tube of the microscope or disturb the object. This is accomplished by the revolving nose-piece, but under the disadvantage of being somewhat bulky; also it answers for only two or three powers, and leaves the unused objectives exposed to the dust. The Facility nose-piece, the Zentmayer cut-away nose-piece, etc., show that objectives can be attached more quickly than by the ordinary screw; yet, like the screw, these devices require drawing back the tube in order to be attached. It will be a great gain if some way can be devised whereby each objective can be easily and instantly slid into place from the side, the new objective pushing out the one in former use as it is itself pushed in. This would probably involve a square or rectangular plate fixed to the top of the objective, sliding in ways fixed to the instrument tube, or some other equivalent arrangement. It is not, however, my present purpose to discuss the ways and means for gaining the important end of attaching the objective by some more speedy device than the screw, only to call attention to the subject. If no device superior to the screw can be found, by all means, let the fittest survive. On the other hand, it is neither mechanical, nor in the end economical, to let the screw, because it is already in the field, stand in the way of a better device. At the present time both microscopists and manufacturers are agreed on the society screw, and those who prefer nose-pieces have to go to the expense of providing adapters. It will be no more than fair to change the programme. Suppose we agree on some standard form and size of nose-piece, and let those who prefer screws provide the adapters.

By having the nose-piece attached directly to the objective tube, we would do away with screws entirely, also all need of adapters except to tubes already provided with screws.

It may be objected that there are so many possible ways of attaching objectives, that there is no probability of coming to an agreement upon a single standard size and form of attachment whereby the objectives of all makers could be used on every microscope, as they are under the present arrangement of the society screw.

In reply it may be said that we cannot know this until after the attempt has been made. If American microscopists take concerted action for making their needs known, it must result in a great many suggestions as to the proper mechanical devices for securing the desired ends. The resources of mechanicians were not exhausted when the screw was invented. I believe it is only a question of time when the ordinary screw will be replaced by some more expeditious device, perhaps by some form of sliding collar, or, if the term be preferred, by the American nose-piece.

G. H. STONE.

Colorado Springs, Col., March 16.

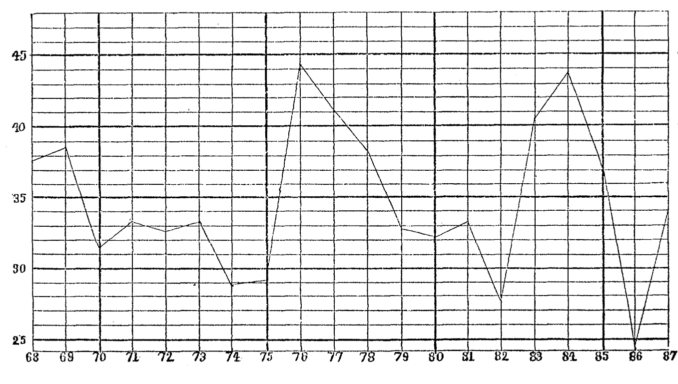
Is the Rainfall increasing on the Plains?

IN your issue of March 2, I observe the statement attributed to the chief signal officer, corroborating "the prevalent opinion that the rainfall in the West is increasing," while Mr. Henry Gannett "dismisses this popular idea as baseless." My own opinion is decidedly in favor of the affirmative of this question. My personal observations for twenty years at this point indicate the existence of a rainfall cycle of about seven years in duration, each septennial period including two or more consecutive years of precipitation above the average, and a similar series of years with precipitation below the average. A seven-year cycle is also illustrated in the Fort Leavenworth rainfall, whose records cover double the period of my own observations at Lawrence. Recognizing the existence of this cycle, it will require a minimum series of fourteen years of records to warrant a division of the period into two equal parts for the purpose of determining the question of an increase of rainfall. I would therefore eliminate from Mr. Gannett's list all but nine of the twenty-six stations. At these stations the aggregate increase of precipitation in the second half of the periods of observation is 109 inches, which gives an average annual increase of 1.28 inches for the nine stations. This is certainly a decided increase, although the average period of observation is only nineteen years.

But the length of the period of observation at Fort Leavenworth is thirty-nine (instead of twenty-eight, as given in Mr. Gannett's table), — from 1836 to 1874. A study of this series of observation is of great interest, since it is the largest series in our possession, and especially since its division into two equal parts throws the first half entirely into the period preceding the settlement of Kansas, while the second half is placed entirely within the period of settlement of this great Commonwealth. The total precipitation in the first half of this period (ending June 30, 1855) was 592.84 inches, giving an annual average of 30.40 inches, while in the second half (ending Dec. 31, 1874) it was 696.29 inches, giving an annual average of 35.70 inches. This shows a total increase of 103.45 inches, or an average annual increase of 5.30 inches. This is assuredly a change worthy of notice, involving an increased precipitation of more than seventeen per cent.

My figures concerning the Fort Leavenworth rainfall are derived from a transcript of the records furnished by Prof. Joseph Henry of the Smithsonian Institution, and published in the 'Annual Report of the Kansas Board of Agriculture for the Year 1874.' In this transcript there are no records for 19 of the 468 months of the 39 years. Five of these blanks occur in the first half of the period, and have been filled by inserting the average precipitation for the months in question. Twelve of the blanks occur in the second half of the period, and have been filled by inserting the actual rainfall for those months at Lawrence, Manhattan, and Fort Riley, all of which stations are within about one hundred miles of Fort Leavenworth, and have a smaller rainfall than that of Fort Leavenworth.

The following diagram is appended as exhibiting more clearly this periodicity according to my observations at Lawrence: —



ANNUAL RAINFALL AT LAWRENCE, KAN., 1868–87.

A similar platting of the Fort Leavenworth rainfall exhibits six periods of excessive precipitation, separated by intervals of seven years, and alternating with periods of deficient precipitation, in the same manner as in the above diagram of the Lawrence rainfall.

F. H. SNOW.

Lawrence, Kan., March 13.

Bacteriology in our Medical Schools.

IN connection with the subject of bacteriology in the schools, it should be stated that Johns Hopkins University, though it has not yet established a medical course, has organized a pathological institute. In this institute the subject of bacteriology is thoroughly taught in the most approved manner by a competent board of instructors.

H. W. CONN.

Middletown, Conn., March 21.